

Effectiveness and effects of mastication and other mechanical treatments on fuel structure in chaparral

Teresa J. Brennan

Dr. Jon E. Keeley



MEDECOS Meeting
October 7th, 2014
Olmue, Chile



Mastication and other Treatments Defined

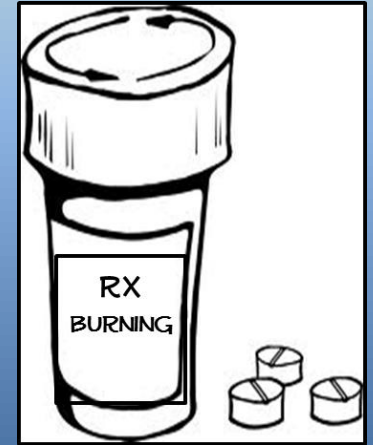
MASTICATION



CRUSHING



PRESCRIPTION BURNING



Mastication – a mechanical fuel treatment that changes the structure and size of fuels. Vegetation is chopped, ground, or chipped and the resulting material is left on the soil surface.



Masticator – generally consists of a cutting attachment and a vehicle to which the cutter is attached.

SMALL



MEDIUM



LARGE



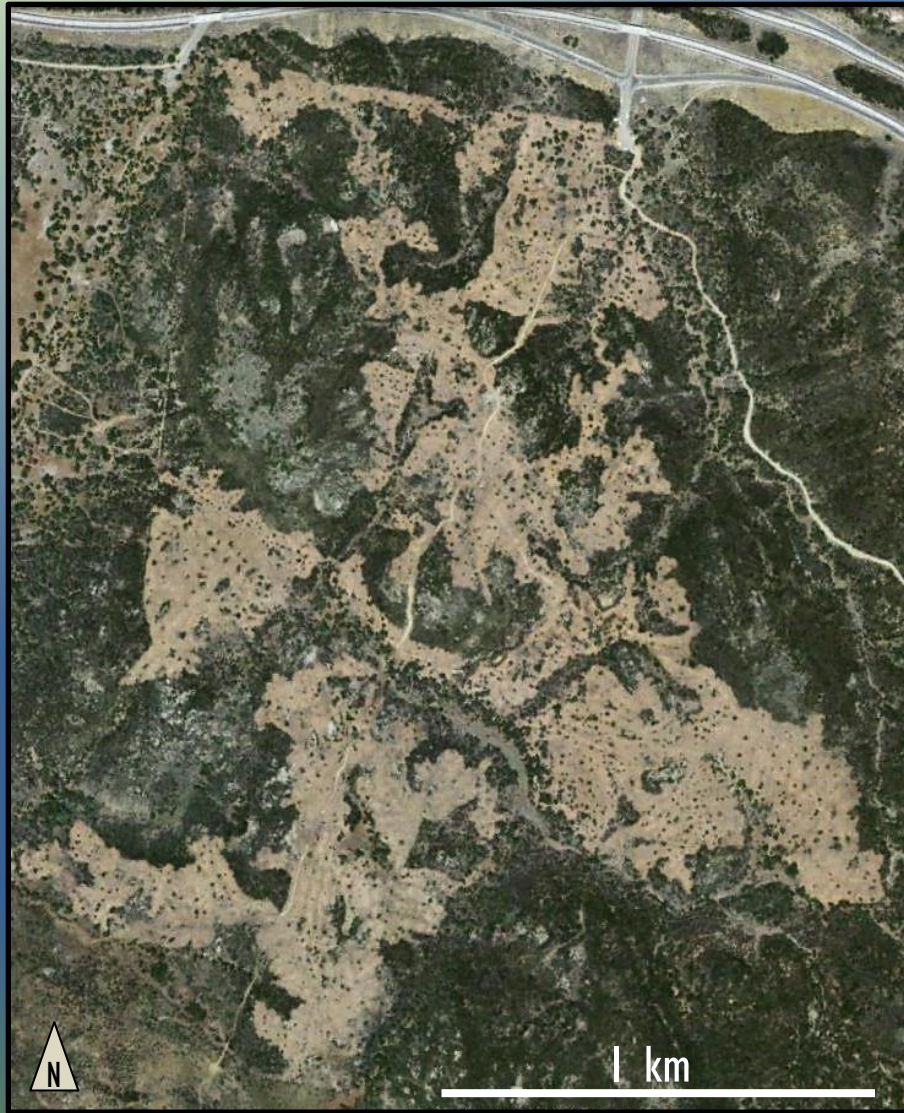
CHOICE OF CUTTING ATTACHMENT

- ROTARY DISC
- HORIZONTAL DRUM



**SELF -
LEVELING
CAB FOR
STEEP
TERRAIN**

Aerial views of mechanical treatments



Corte Madera mastication spring 2008-2009
Cleveland national forest



Leona Divide crushing winter 2008-2009
Angeles national forest

It is clear that these treatments alter fuel structure but....

How do we quantify this change?

How long does the treatment last?

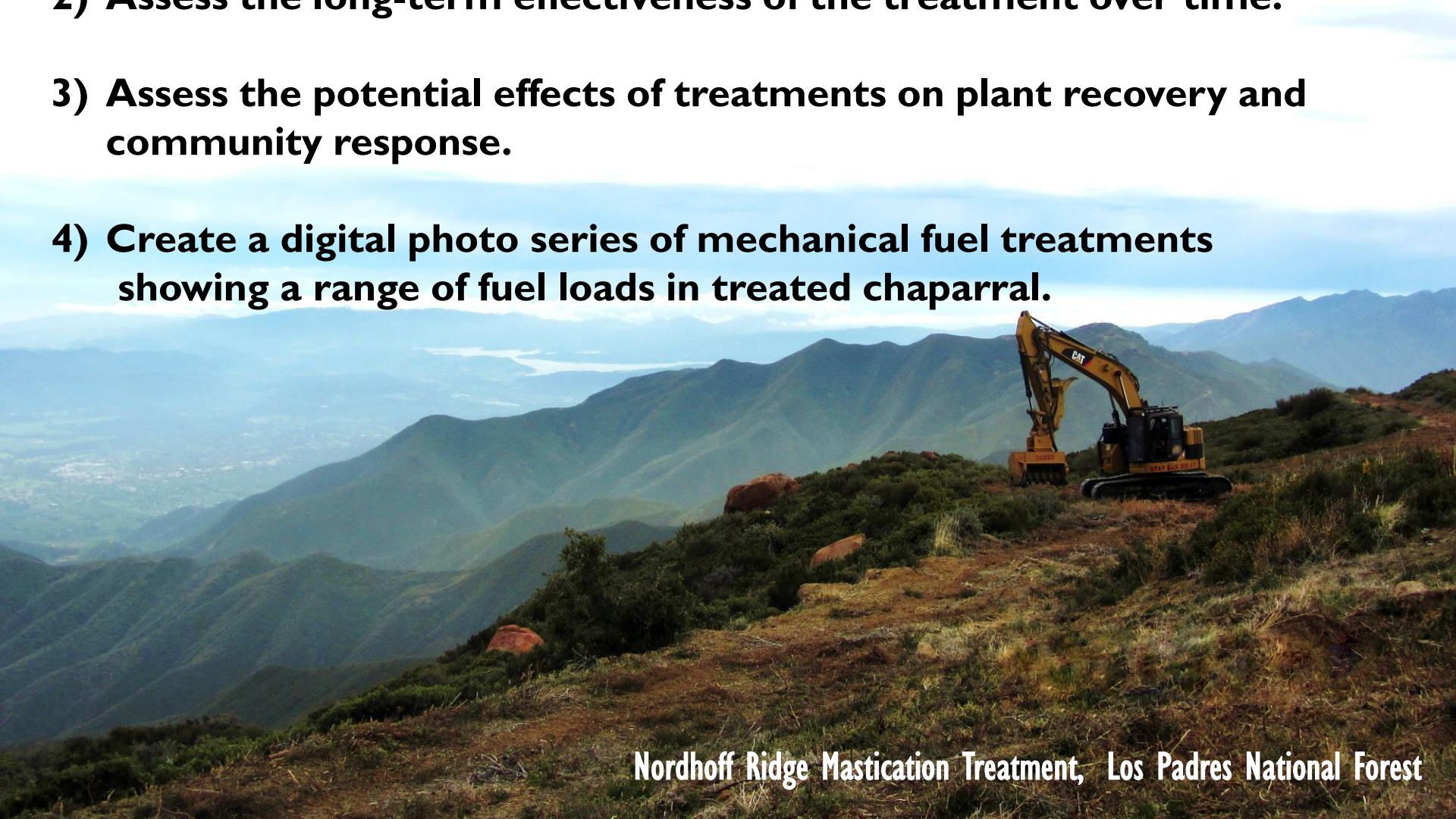
What are the ecological effects?



East Camino Cielo mastication treatment, Los Padres national forest

Primary Study Objectives

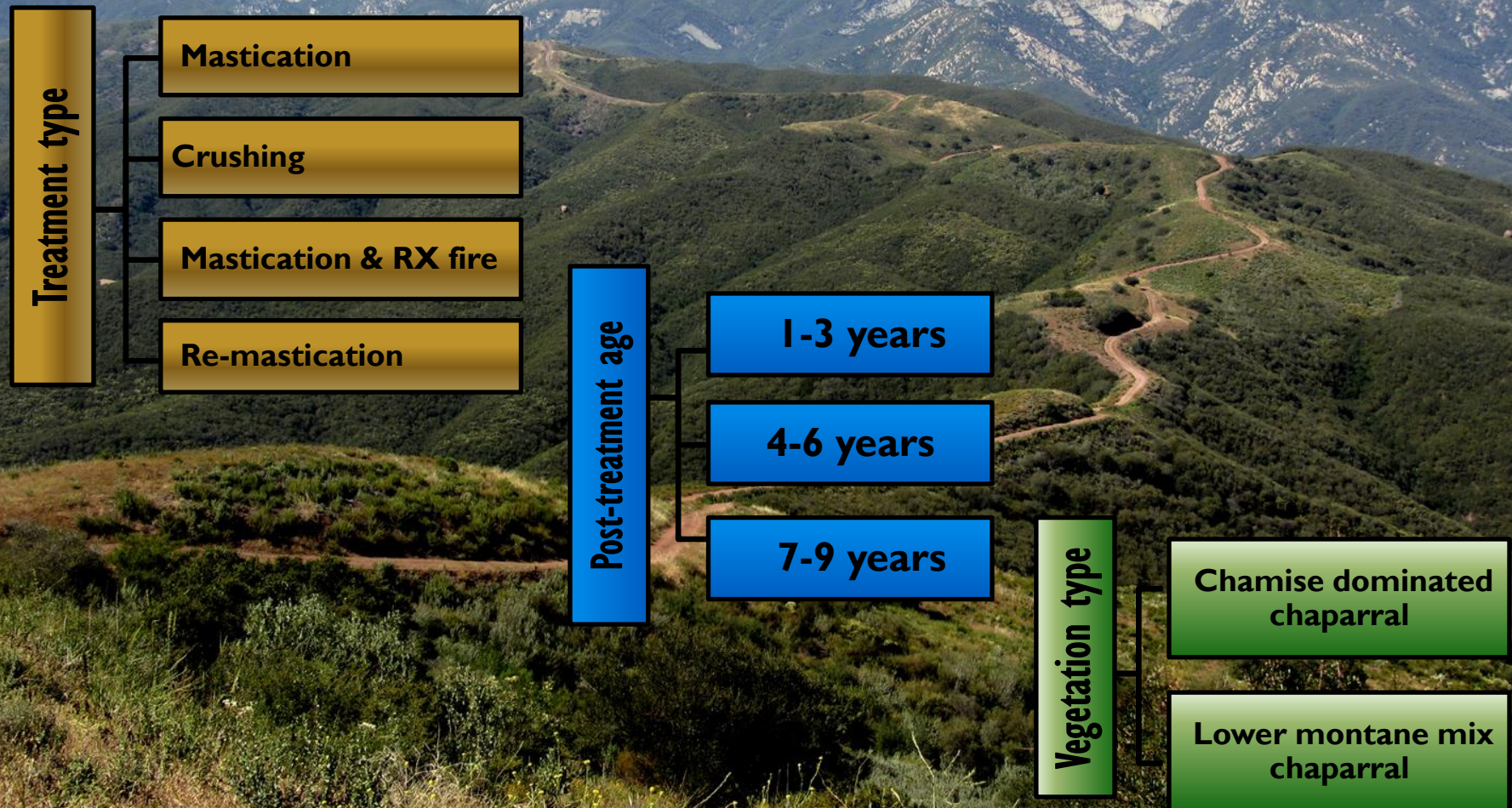
- 1) Determine fuel bed composition and structure following treatment.**
- 2) Assess the long-term effectiveness of the treatment over time.**
- 3) Assess the potential effects of treatments on plant recovery and community response.**
- 4) Create a digital photo series of mechanical fuel treatments showing a range of fuel loads in treated chaparral.**



Nordhoff Ridge Mastication Treatment, Los Padres National Forest

Study Site Selection

Study sites were selected across all four southern California forests and stratified by treatment type, post-treatment year & vegetation type.

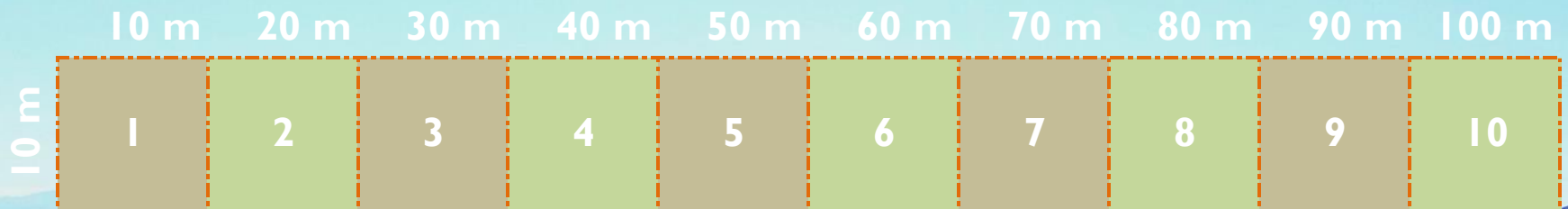


Study Site Locations



Study Site Design & Methodology

Treatment survey design



Control survey design



Fuel and vegetation surveys in treatments.

Vegetation surveys in controls

Stem samples from controls to determine pre-treatment age



Lone Pine Mastication 2005, Wildfire 2009,
San Bernardino National Forest

Objectives 1 & 2. Fuel bed structure and composition following treatment & the effectiveness over time.

Analyzed fuel load by looking at 4 main components.

Live woody fuels

Live herbaceous fuels

Dead herbaceous fuels
& litter

Downed woody fuels
(treatment debris)



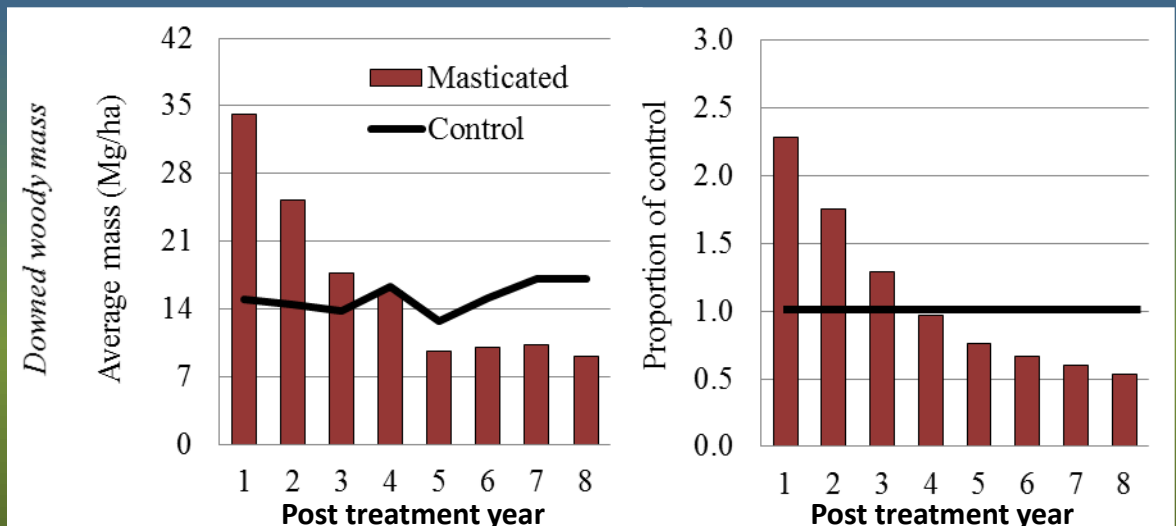
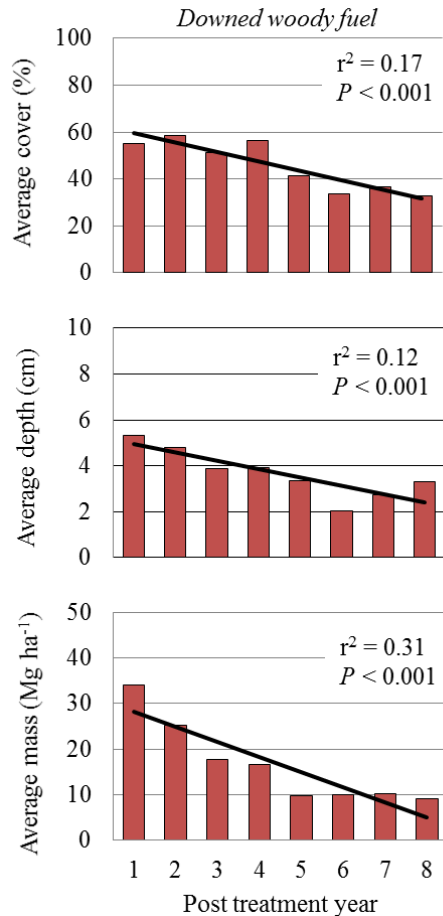
Downed woody fuels

Significant decrease in cover, depth, and mass over time as was expected due to decomposition.

Comparison to Control

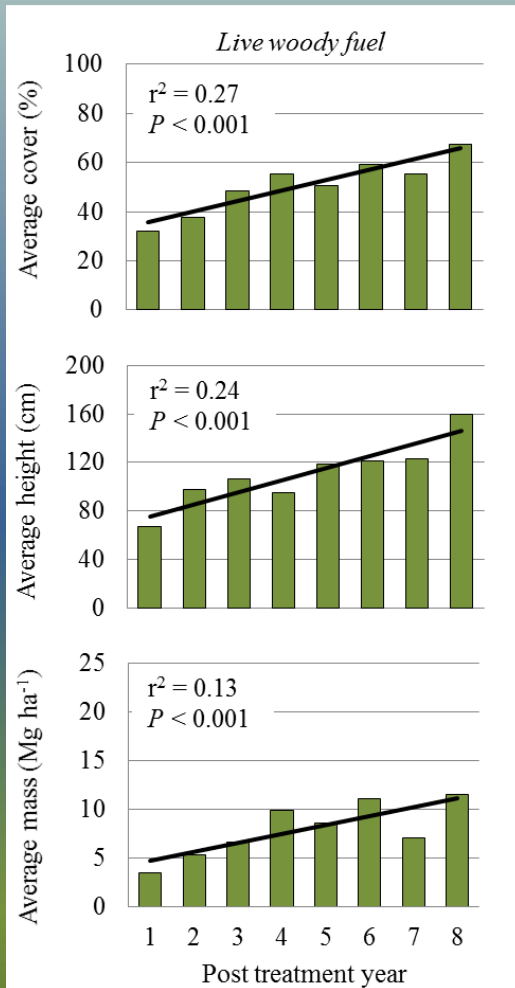
Control mass estimated from FCCS models

- Year 1 – treatment mass 2.25 > control mass
- Year 4 – treatment mass = control mass
- Year 8 – treatment mass .5 of control mass



Live woody fuels

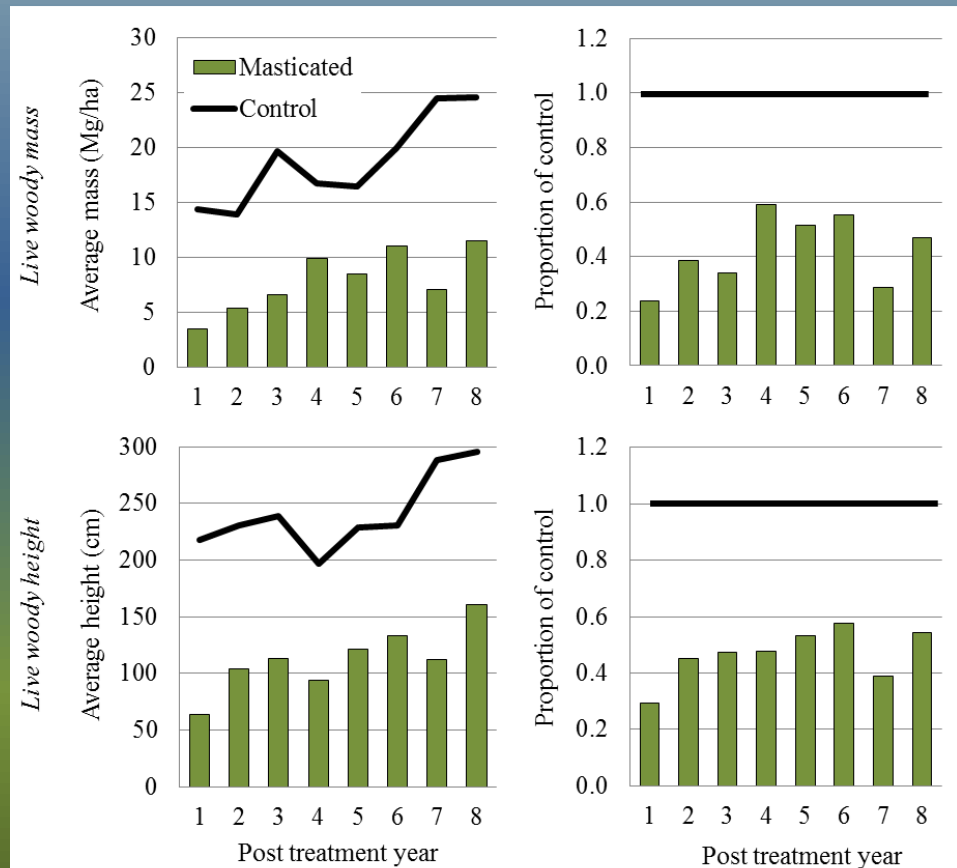
Significant increase in cover, height, and mass over time.



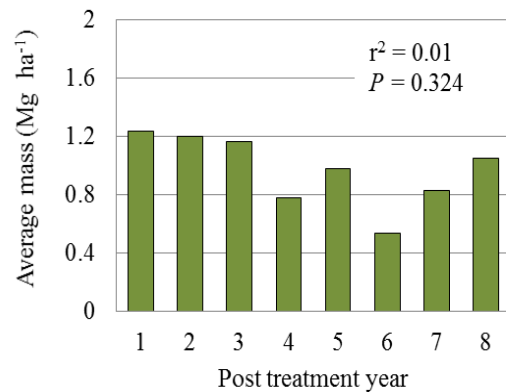
Comparison to Control

By post treatment years 4-5 both mass and height are at ½ of the control mass and height.

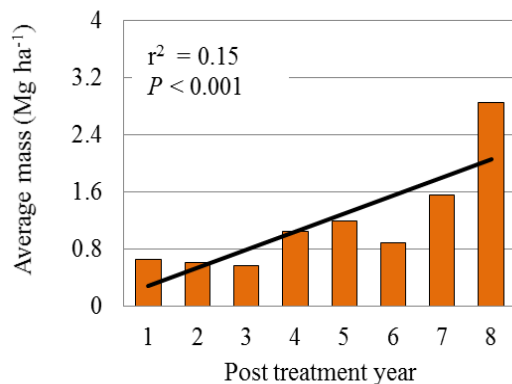
Longevity of treatment is determined by the re-growth of woody vegetation.



Live herbaceous fuel



Dead herbaceous & litter



Herbaceous fuels

- Not a significant decrease in live herbaceous mass over time.
- Significant increase in dead herbaceous mass over time

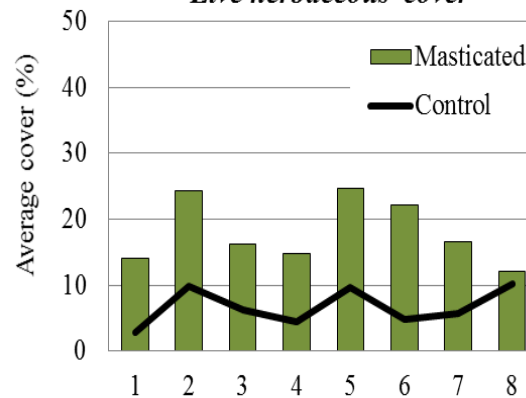
Comparison to Control

Live herbaceous cover

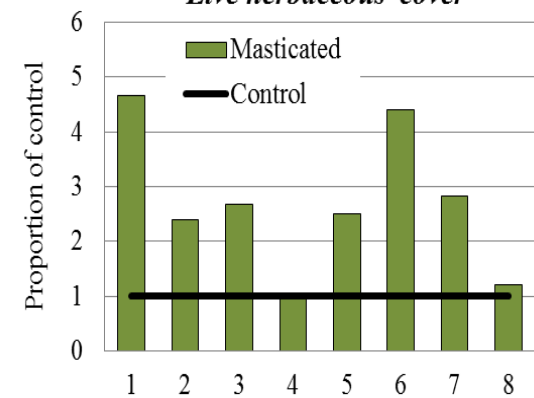
- 3-10% in controls
- 12-25% in treatments
- 1-4.5 times the cover in controls



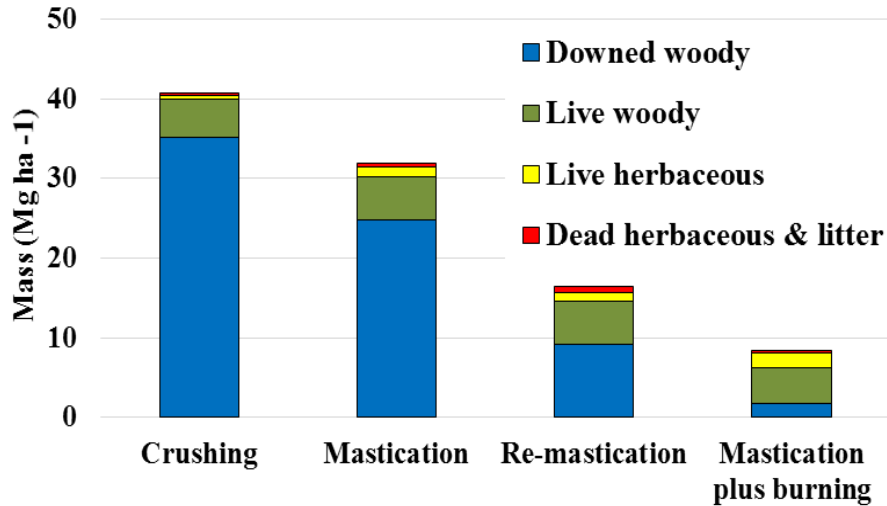
Live herbaceous cover



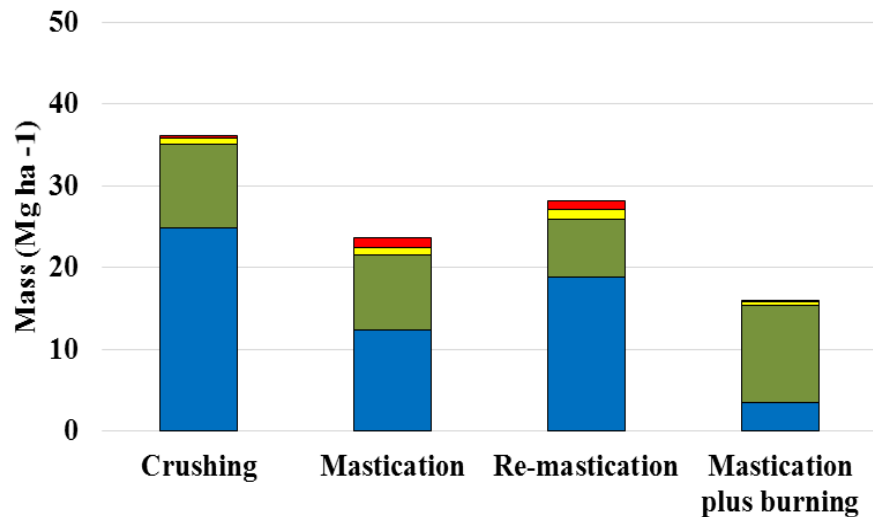
Live herbaceous cover



1-3 years following treatment



4-6 years following treatment



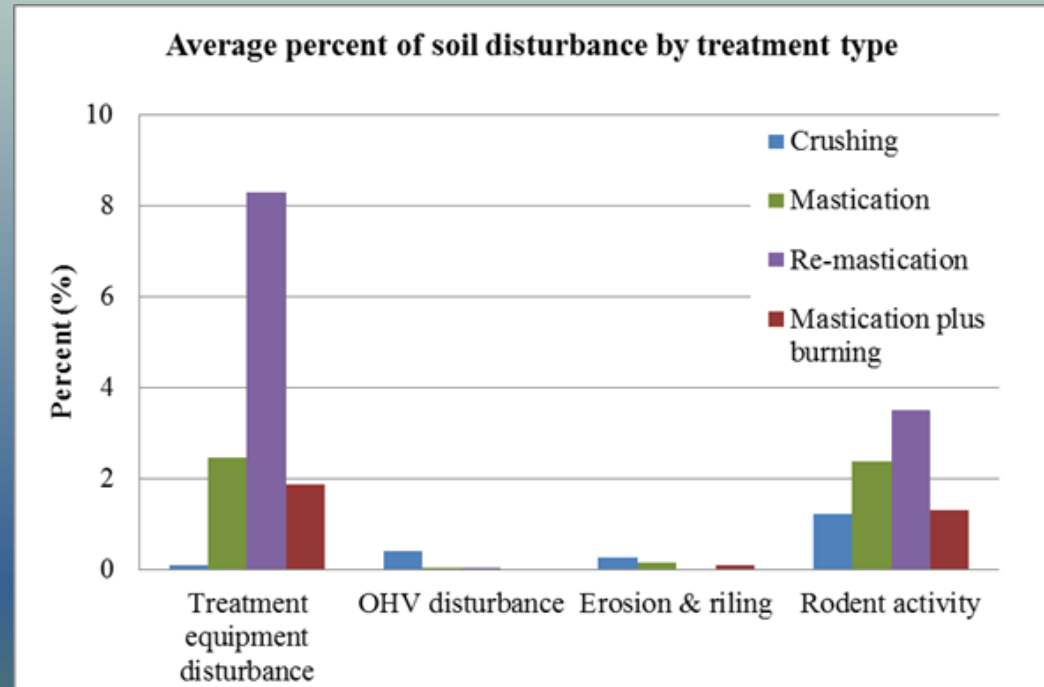
Comparison by treatment type

- Fuel reduction was greatest for mastication plus burning
- Crushing treatments had the lowest fuel reduction
- Re-masticated treatments initially had more reduction in fuels but over time showed an increase
- Mastication treatments had the greatest increase in herbaceous fuels

Objective 3. Potential effects of treatments on plant recovery, community response, and soil disturbance.

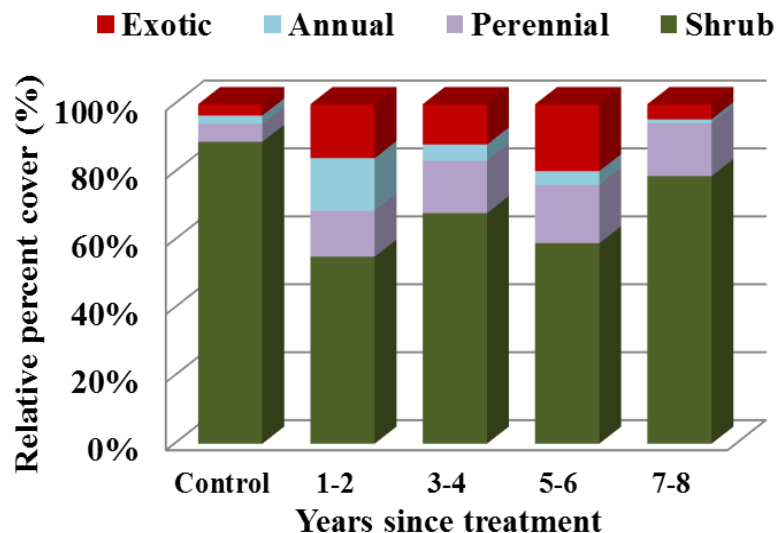
Concerns of resource managers:

- Soil compaction
- Soil erosion and riling
- Soil equipment disturbance
- Increased OHV use/disturbance
- Habitat loss
- Exotic species
- Type conversion

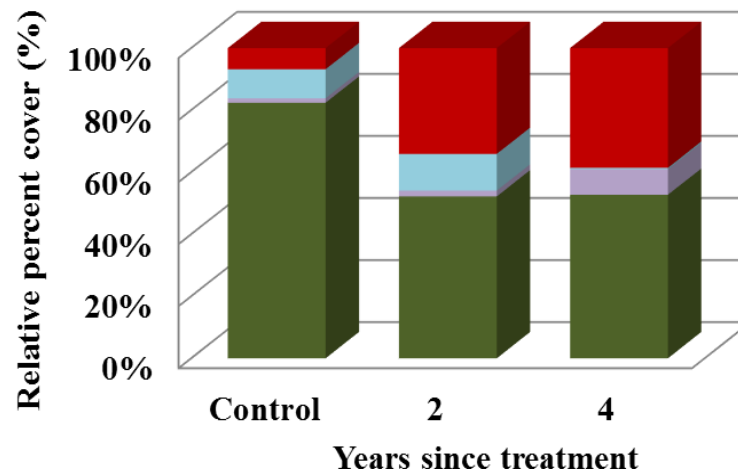


Community composition and exotics

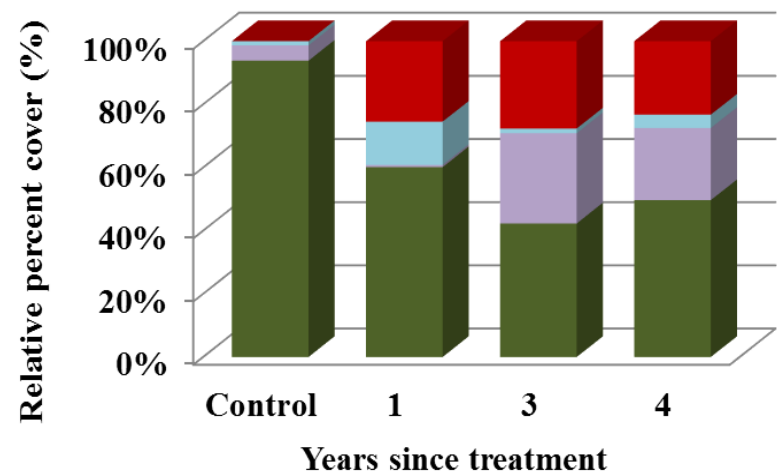
Mastication



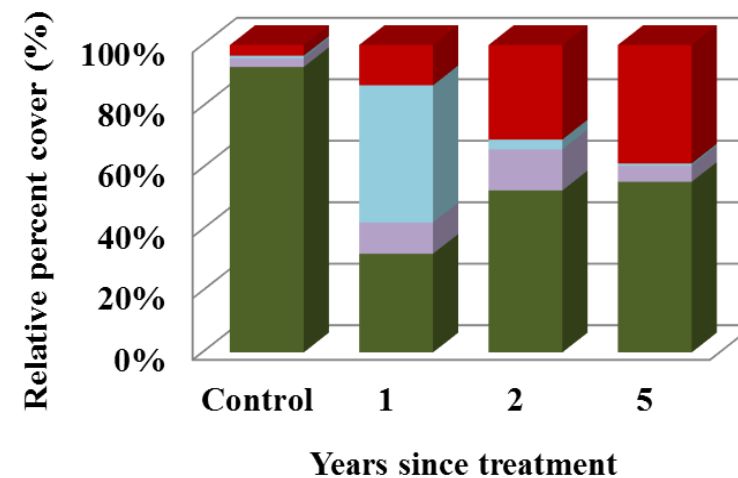
Crushing



Re-mastication



Mastication plus burning





Objective 4. Create a digital photo series of mechanical fuel treatments in chaparral.

Management tool that can be used to quickly assess fuel loading in treatments

Photos from over 40 sites in various vegetation types

SITE INFORMATION		SITE COVER AND HEIGHT		SITE FUEL LOAD		(tons/acre)
State	California	SRM cover type	Scrub oak mixed chaparral	Total fuel load		17.42
Coordinates	11 S 545030 E 3631538 N	Pre-treatment cover type	Manzanita	Downed Woody Fuels		
Land owner	Cleveland National Forest	Pre-treatment height	9 feet	1 hr		1.74
Treatment type	Mastication	Live woody height	4 feet	10 hr		4.06
Treatment name, year	Pine Valley, spring 2008	Treatment debris cover	66%	100 hour		1.80
Years since treatment	3 years	Live woody cover	12%	1000 hour		0.00
Age at time of treatment	39 years	Herbaceous cover	4%	Live woody fuels		9.55
Elevation:	3865 feet	Exotic cover	1%	Herbaceous live fuels		0.10
Slope	5 degrees	Native cover	15%	Dead herbaceous & litter fuels		0.17
Aspect	West					
SITE SPECIES						
Shrubs	<i>Adenostoma fasciculatum</i> , <i>Adenostoma sparsifolia</i> , <i>Arctostaphylos glauca</i> , <i>Ceanothus greggii</i> , <i>Ceanothus leucodermis</i> , <i>Cercocarpus betuloides</i> , <i>Quercus agrifolia</i> , <i>Quercus berberidifolia</i>					
Subshrubs	<i>Eriogonum fasciculatum</i> , <i>Rhus trilobata</i>					
Perennials / Suffrutescents	<i>Astragalus douglasii</i> , <i>Galium andrewsii</i> , <i>Gnaphalium canescens</i> , <i>Lonicera interrupta</i> , <i>Paeonia californica</i> , <i>Penstemon spectabilis</i> , <i>Phacelia ramosissim</i>					
Annuals	<i>Calandria ciliata</i> , <i>Camissonia hirtella</i> , <i>Claytonia perfoliata</i> , <i>cordylanthus rigidus</i> , <i>Cryptantha intermedia</i> , <i>Eriogonum baileyi</i> , <i>Oxytheca trilobata</i> , <i>Stephanomeria exigua</i> , <i>Stephanomeria virgata</i>					
Exotics	<i>Bromus tectorum</i> , <i>Erodium cicutarium</i> , <i>Lactuca serriola</i> , <i>Sisymbrium altissimum</i>					

Vegetation Classes:

- **Adenostoma dominated chaparral**
- **Arctostaphylos dominated chaparral**
- **Ceanothus dominated chaparral**
- **Quercus dominated chaparral**
- **Lower montane chaparral mix**

Fuel loads:

- **Range from 11-90 Mg/ha
(5-40 tons/acre)**



Adenostoma dominated chaparral mix
Hwy 74 mastication spring 2007
Vegetation 5 yrs. since treatment
Fuel load 22.3 Mg/ha (10 tons/acre)



Arctostaphylos dominated chaparral mix
Pine Valley mastication spring 2008
Vegetation 4 yrs. since treatment
Fuel load 39.1 Mg/ha (17.4 tons/acre)

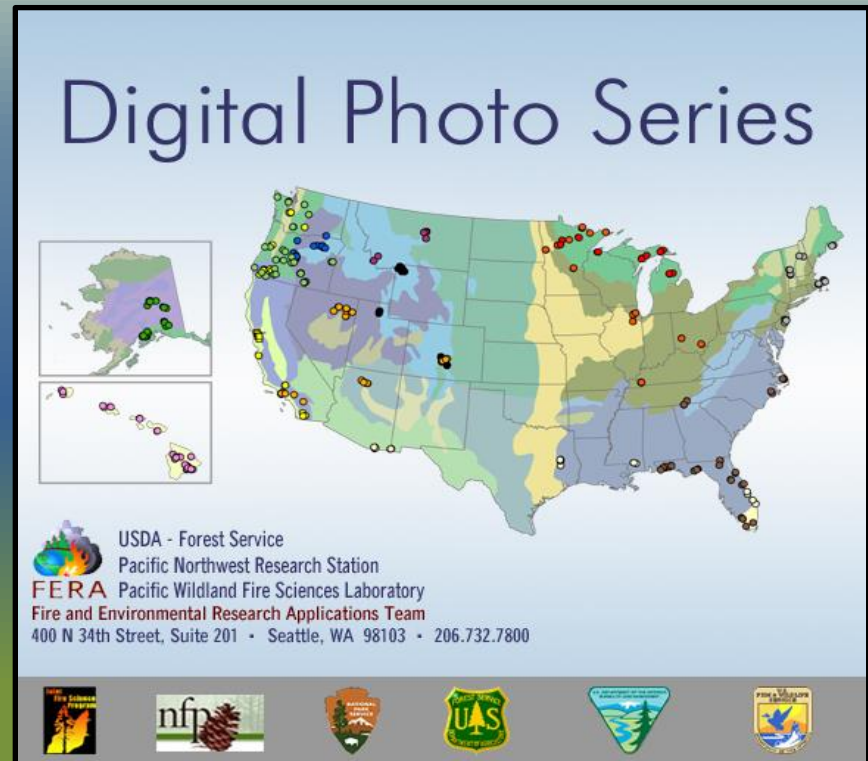


Lower montane chaparral mix
Leona Divide mastication fall 2009
Vegetation 3 yrs. since treatment
Fuel load 60.9 Mg/ha (27.2 tons/acre)

Will be available for resource managers online at the California Fire Science Consortium website and at the Digital Photo Series website in the near future.



<http://www.cafiresci.org>



<http://depts.washington.edu/nwfire/dps/>

Take home message

The good

Initial treatment reduces canopy height and live-woody cover by two-thirds, while concentrating downed-woody fuels at the surface.

The bad

Treatment longevity is short-term in chaparral dominated landscapes due to the re-sprouting capability of many shrub species.

Follow-up treatments increase herbaceous fuels and exotic species which increases the potential for type conversion.

The ugly

Increases in herbaceous annual plants = increased ignition potential!

Special Thanks to

Joint Fire Science Program & USDA Forest Service

2011 Field Crew

Chelsea Morgan, Callen Huff, Graydon Dill & Richard Mansfield

2012 Field Crew

**Chelsea Morgan, Callen Huff,
Warren Reed & Anthony Baniaga**



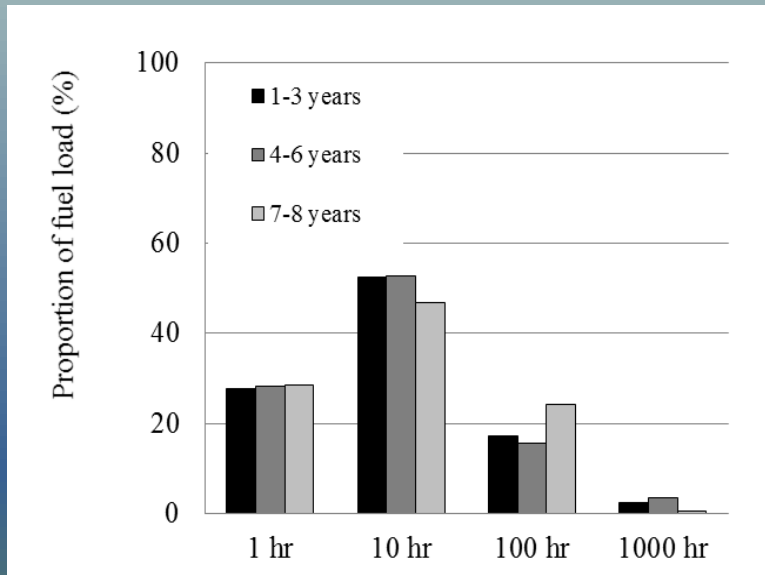
Field Crew 2011



Field Crew 2012

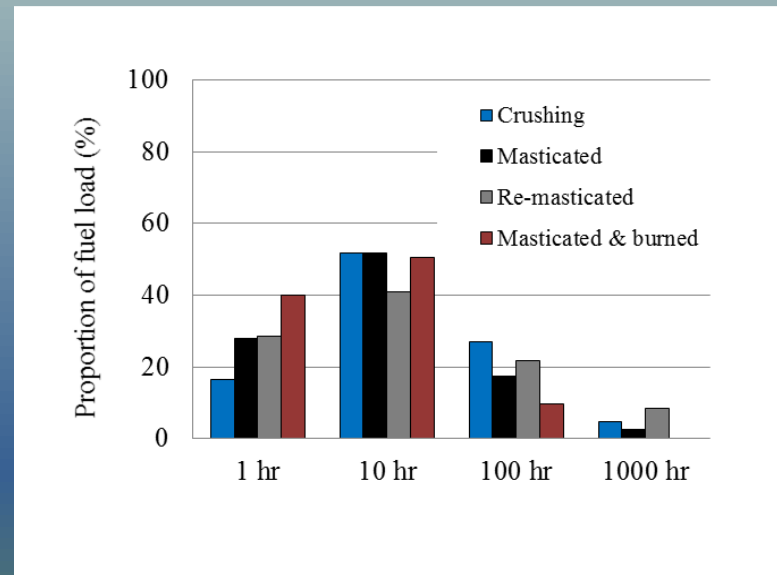
Comparison of downed woody fuel load by treatment type

Mastication



Proportion of total fuel load by fuel class did not change significantly over time for mastication or other treatments

All treatments



There were significant differences in the proportions of fuel load by fuel class between treatment types

Vegetation Survey

Control subplot



✎ Percent cover & density for each species within 1 m² nested subplots

✎ Average height & percent cover within 2 m² nested subplot

✎ List additional species within the 10 m² subplot

✎ Stem samples were taken from obligate seeding species within the control to determine stand age at time of treatment

Treatment subplot



Fuel & Cover Surveys

?

3

7

Percent cover values 10 m²

- * treatment debris
- * untreated shrubs
- * standing dead fuels
- * herbaceous fuels
- * live woody fuels
- * bare ground
- * rock
- * rilling/erosion
- * rodent activity
- * equipment disturbance
- * OHV disturbance
- * other

✎ All fuels surveyed within a ½ m² pvc frame

✎ Depth/height recorded

✎ All Fuels within the frame collected & separated by class, then weighed

Live woody fuels

Downed & treated fuels

Litter & herbaceous fuels

Fuel moisture